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(21) Application No. 43479/76 (22) Filed 20 Oct. 1976
(31) Convention Application No. 7511712 (32) Filed 20 Oct. 1975 in
(33) Sweden (SE)
(44) Complete Specification published 2 May 1979
(51) INT. CL.² B05B 15/04
(52) Index at acceptance
B2L 121 122 124 301 A

(54) AN IMPROVED DEVICE FOR SURFACE TREATMENT OF OBJECTS HAVING LARGE SURFACES E.G. SHIPS, CISTERNS OR THE LIKE

(71) I, RALF LARSON, a Swedish Subject of Myrbacksvagen 31, 436 00 Askim, Sweden, do hereby declare the invention for which I pray that a Patent may be granted to me and the method by which it is to be performed, to be particularly described in and by the following statement:–

The present invention refers to a device for surface treatment of objects having large surfaces, e.g. ships, cisterns or the like, independent of unfavourable external weather conditions such as rain, snow, water, winds etc. during the treatment process, which device includes a mobile transport unit designed to be movable along the surface to be treated and equipped with contrivances for retaining the unit in engagement with the treatment surface during such movement, by means of an attraction force effected relative to said surface, and having a housing carried by said transport unit which is open against the treatment surface.

Surface treatment of, for instance ships, is marred by a plurality of severe problems, partly depending upon the size of and the difficulty of access to such surfaces and partly depending on external, unfavourable external weather conditions such as rain, snow or winds which will wet the treatment surface. Due to the size of the surfaces it has hitherto been impossible to utilize the most efficient surface treatment methods, such as for instance electrostatic powder coating, as after the powder coating has been effected, the surface must be heat treated at an elevated temperature, which hitherto has had to be done in special heat treatment furnaces. Surface treatment of the shelving of a ship today requires an extensive scaffolding work, which entails large costs. Furthermore once the ship has been launched an additional complication will be that maintenance and repainting might take place during unsuitable weather when the ship might be at port and it can therefore happen that the painting must be done on a moist base, which with earlier contrivances will entail an unsatisfactory result.

The object of the present invention is to eliminate those drawbacks and to provide a device which is able to effect a surface treatment quite independent of weather and wind, possibly even below the water surface, and without the use of scaffolding. A further object is to provide a device which will enable advanced surface coating methods to be used which methods can generally be used at stationary plants only.

According to the present invention there is provided a device for the surface treatment of objects having large surfaces, e.g. ships, cisterns or the like, independent of unfavourable external weather conditions such as rain, snow, water, winds etc. during the treatment process, which device comprises a mobile transport unit designed to be movable along the surface to be treated and equipped with contrivances for retaining the unit in engagement with the treatment surface, during such movement, by means of an attraction force effected relative to said surface, and having a housing carried by said transport unit which is open against the treatment surface, wherein the housing is provided with means adapted to form a seal against the treatment surface and to screen off against the environment, the housing further enclosing surface treatment apparatuses including equipment for application of a surface treatment medium and at least one heating station adapted to establish in the housing an atmosphere favourable to the treatment, and to bring about a swift drying and/or curing of the treated surface.

According to a further feature, the surface treatment apparatuses comprise stations interconnectable section by section, such as for instance a sand blasting station with or without means for sand recovery, a dust suction station, a brushing station, an air or liquid rinsing station, at least one station for application of the coating material, and a drying and/or heat treatment station.

It is preferable that the transport unit in-

cludes at least one application station and two heating zones situated one on each side of the application station, whereby the transport unit is able to bring about a surface treatment during movement forward or rearward.

According to a further aspect of the invention the transport unit is provided with control elements for steering the unit in relation to one longitudinal edge of an immediately preceding treatment area and/or in relation to marks applied during a preceding treatment.

It is further preferable that the parts of the transport unit with which it is contacting the treatment surface are adjustable in two directions for adaption to the curvature of the treatment surface, namely in the direction of motion of the device and in a plane transverse to said direction of motion.

The invention will now be further described, by way of example, with reference to the accompanying drawings in which:—

Figure 1 shows schematically a device according to the invention as seen in a view from above,

Figure 2 shows a section along line II—II in Figure 1,

Figure 3 is a section along line III—III in Figure 1,

Figure 4 shows a modified embodiment of the invention in a view corresponding to Figure 2,

Figures 5 and 6 show in side elevations the device during movement along a surface which in the longitudinal direction is straight and curved respectively,

Figures 7 and 8 are frontal views showing the device during movement over a laterally straight and curved surface respectively, and

Figure 9 shows in a longitudinal section through a device according to the invention an embodiment of a driving machinery for the device.

The device according to the invention shown in Figures 1 to 3 comprises a transport unit 1 designed as a tracked vehicle, which as shown in Figure 1, comprises two longitudinal endless tracks 2 and a transverse track 3. Such tracked vehicles are earlier known, being shown for instance, in Swedish Patent No. 223,683. The endless tracks of the tracked vehicle are provided with contrivances which against the treatment surface, generate an attracting power flow of such a magnitude that the vehicle is retained at the treatment surface. These contrivances can be permanent magnets, electromagnets or suction cups. With suction cups, the cups concurrently with the movement of the tracked vehicle, are sucked by means of a suction pump to adhere against the surface.

The transport unit 1 carries a housing 5 which is open against the treatment surface 4 and sealed off against the environment by aid of sealing means 6 arranged at the wall portions of the housing directed towards the treatment surface 4. The housing thus encloses a room which at the bottom is defined by the treatment surface 4 and due to the fact that the room is separated from its environment it is possible therein to maintain an atmosphere which is favourable for the treatment.

The housing is preferably separated into sections forming a number of stations, which either form a unity with the housing, or are interconnected to form said housing. In the embodiment shown in Figures 1 to 3 the sections as seen from left to the right in the drawings, are, a drying and moisture expelling station 7, a blasting station 8, which may be provided with a sand recovery apparatus, a dust suction station 9, a brushing station 10, an air or liquid rinsing station 11, at least one station 12 for application of the coating material, and a drying and/or heat treatment station 13 designed as a heat source, which for instance works with infra-red radiation.

The transport unit is intended to be moved to the left as shown in the drawing, whereby the drying station 7 first dries the treatment surface if this is wet. The stations can also be formed so that they are mutually exchangeable, and it may for instance in some cases be suitable to arrange a cleaning station in front of the drying station 7 where the treatment surface either is rinsed with air or with liquid and is washed with water and detergents. Dust and dirt from the rinsing operation are transported to a common store tank 15. In view of the type of surface coating material used it is possible to arrange in front of the application station 12, a heater, for example, an infra-red heater, which heats the treatment surface. As the application of the coating material can be made in a suitable atmosphere and a drying and heat treatment station can be arranged in connection to the application station, it is possible to choose powder spraying as an application method, which spraying is performed in a known manner by aid of a high tension apparatus 16, a powder container 17 and spraying nozzles 18. In connection to the application station 12 can, in known manner, be arranged a powder recovery device 18', by means of which excess powder is brought back to the container 17. Due to the fact that the treatment surface is heated prior to the application of the powder, this will bake to some extent and an improved adherence is achieved.

The transport unit, during its movement, thus leaves a broad, coated, dried and/or heat treated surface band, and the transport unit is steered by means of a control element 19, which senses one of the longitudinal edges of the immediately preceding treatment area, or marks applied adjacent to this longitudinal edge during the preceding treatment. These marks can be paint marks in the form of a string of points, but they can also consist of radio-active isotopes. The sensing members of the control element depends upon the type of markings used, but can be a photocell device, or

members sensitive to radio-active radiation.

The embodiments of the device shown in Figures 1 to 3 can by aid of the two sets of endless tracks 2 and 3 which are arranged perpendicular to each other be moved laterally at the end of a surface treated and thereupon cover the next area by being driven longitudinally.

The driving device of the transport unit is in Figures 1 to 3 of the drawing designated 20 and it can preferably be an air motor, which via a conduit for pressurized air, is fed from a further source of pressurized air (not shown), which is, for instance, in the case of a ship being treated, located on the ship's deck. The propulsion of the transport unit can of course be arranged in other ways than by means of the endless tracks, for example the unit may hang on a wire which is connected to a winch on the ship's deck. The engagement force against the treatment surface may also be achieved by means of a reduced pressure within the housing.

In view of the different functions allotted to the separate stations, the housing can either be hermetically closed relative to the environment or it may communicate therewith, which latter can be appropriate in such cases where air circulation is desired. The expression "the housing" can mean a housing incorporating all the stations, but it is also possible to design each separate station as a housing, in which the appropriate atmosphere for the particular station is maintained. The stations can be pivotably attached to each other, and form "a train" which can adapt itself to curved surfaces.

In Figure 4 there is shown, in a longitudinal section, a further embodiment of a device of the invention, which mainly corresponds to the elevation according to Figure 2. Details of this device which correspond to details in the embodiment shown in Figures 1 to 3 have been given the same reference numerals as in the earlier described version. The transport unit 1 is thus tracked and provided with two longitudinally arranged endless tracks 2. These endless tracks are, as the tracks earlier, described adapted to give a retention of the transport unit to the surface to be treated also when the device for instance "climbs" substantially vertical surfaces. The separate track portions of the endless tracks may thus for instance be designed as magnet plates. The transport unit carries a housing open against the treatment surface which housing with appropriate means is sealed off and/or screened off relative to the environment.

The housing of the transport unit 1 shown in Figure 4 has at each one of its ends a sand blasting zone, which includes at least one sand blasting nozzle 8 and preferably also a dust expelling nozzle 9. Beyond each one of the blasting zones in a direction towards the centre of the housing there is arranged a heating zone 13, which can be provided with radiation tubes for emitting infra-red radiation or is equipped with another type of heating apparatus capable of establishing an elevated temperature which can dry a wet surface prior to the treatment with the coating medium and above all is able to dry and preferably also cure a surface-treated surface area. Between the two heating zones 13 there is a surface treatment zone 12 where the medium used shall be applied to the surface, for example, via one or more nozzles. This modified version of the device according to the invention differs from the one shown in Figures 1 to 3 regarding the equipment of the transport unit, whereby the pre-drying station 7, the brush station 10 and the air or liquid rinsing station 11 have been omitted, whereas instead two sand blasting zones 8 and two heating stations 13 have been incorporated. This duplication has made it possible to drive the device during treatment in either of the two main directions defined by the direction of the endless tracks. The equipment shown in the Figure can however be supplemented with further stations in accordance with the embodiment shown in Figures 1 to 3 if it should be considered appropriate for any specific case of use.

The important condition is that the transport unit forms a working site which is substantially screened off from the environment, in which working site there is at least one heating zone being capable of giving a suitable atmosphere for the surface treatment operation and a possibility of instantly drying and curing the layer applied to the surface to be treated, which is a basic condition for allowing the device to be moved comparatively rapidly even during weather conditions which are unfavourable for a newly applied surface treatment layer which has not been dried or cured.

Figure 5 shows in a side elevation a device constructed according to the invention during movement on a straight surface 4. The transport unit 1 is provided with at least two pairs of wheels 21 and 22 respectively which together carry the endless tracks 2. One of the pairs of wheels 22 is, in the embodiment shown, displaceable by means of hydraulic cylinders 23 in the longitudinal direction of the transport unit, and it is thus possible hereby to adjust the tension of the endless tracks also during movement. Figure 6 shows, in a view corresponding to Figure 5, how this feature can be utilized when the transport unit 1 moves over a surface 4' which is curved in the longitudinal direction of the transport unit, whereby the hydraulic cylinder or cylinders 23 have moved the movable pair of wheels 22 towards the other pair of wheels 21 and thereby slackened the tension in the endless tracks 2 so that the tracks can closely adapt themselves to the curved treatment surface 4'. This is a valuable feature in order to be able to maintain a sufficient attraction power between the treatment surface and the transport unit 1 when this passes over curved surfaces.

Figure 7 shows in a front view, the transport unit 1 during movement over a plane treatment surface 4. Each separate wheel is fitted to a pivotable bracket 24, which as can be further seen from Figure 8 where the transport unit 1 moves over a transversely curved surface, can be pivoted, preferably by means of hydraulic actuation, to an angular position where each of the wheels 21 will take up a position essentially parallel to the curved treatment surface 4' at the points where said wheels contact said surface. It is to be understood that the wheels of the rear wheel pair 22 are freely adjustable in the same manner as the wheels of the front wheel pair 21, whereby is ensured that the transport unit 1, even during movement over laterally curved surfaces, will have an optimal engagement against the treatment surface. It is of course possible simultaneously to adjust the contact of the endless tracks against the treatment surface longitudinally and laterally if necessary.

Figure 9 shows an embodiment of a driving machine 20 for a device constructed in accordance with the invention and this driving machine 20 includes in the shown embodiment electric motors 25, a hydraulic pump 26, a hydraulic motor 27 and a worm gearing 28 by means of which the power from the hydraulic motor is transferred to at least one of the pairs of wheels.

WHAT I CLAIM IS:–

1. A device for surface treatment of objects having large surfaces, e.g. ships, cisterns or the like, independent of unfavourable external weather conditions such as rain, snow, water, winds etc. during the treatment process, which device comprises a mobile transport unit designed to be movable along the surface to be treated and equipped with contrivances for retaining the unit in engagement with the treatment surface, during such movement, by means of an attraction force effected relative to said surface, and having a housing carried by said transport unit which is open against the treatment surface, wherein the housing is provided with means adapted to form a seal against the treatment surface and to screen off against the environment, the housing further enclosing surface treatment apparatuses including equipment for application of a surface treatment medium and at least one heating station adapted to establish in the housing an atmosphere favourable to the treatment, and to bring about a swift drying and/or curing of the treated surface.

2. A device as claimed according to claim 1, wherein the surface treatment apparatuses comprise stations interconnectable section by section.

3. A device as claimed in claim 2 comprising at least two of the following stations, namely a sand blasting station with or without means for sand recovery, a dust suction station, a brushing station, an air or liquid rinsing station, at least one station for application of the coating material, and a drying and/or heat treatment station.

4. A device as claimed in claim 1, wherein the transport unit includes at least one application station and two heating zones situated one on each side of the application station, whereby the transport unit is able to bring about a surface treatment during movement forward or rearward.

5. A device as claimed in any one of the preceding claims, wherein the transport unit is provided with control elements for steering the unit in relation to one longitudinal edge of an immediately preceding treatment area and/or in relation to marks applied during a preceding treatment.

6. A device as claimed in any one of the preceding claims, wherein the parts of the transport unit with which it is contacting the treatment surface are adjustable in two directions for adaption to the curvature of the treatment surface, namely in the direction of motion of the device and in a plane transverse to said direction of motion.

7. A device for surface treatment of objects having large surfaces substantially as hereinbefore described with reference to and as shown in Figures 1 to 3 of the accompanying drawings.

8. A device for surface treatment of objects having large surfaces substantially as hereinbefore described with reference to and as shown in Figure 4 or Figures 5 and 6 or Figures 7 and 8 or Figure 9 of the accompanying drawings.

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Printed for Her Majesty's Stationery Office by MULTIPLEX techniques ltd., St Mary Cray, Kent. 1979. Published at the Patent Office, 25 Southampton Buildings, London, WC2 1AY, from which copies may be obtained.

FIG. 1

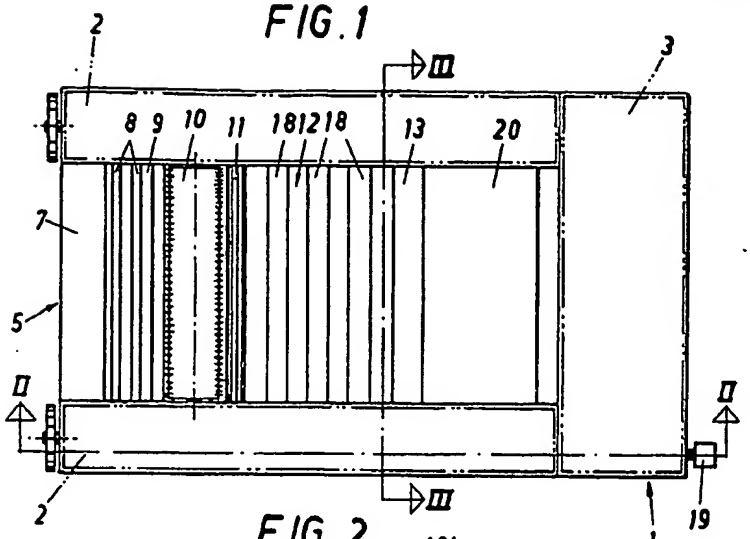

FIG. 2

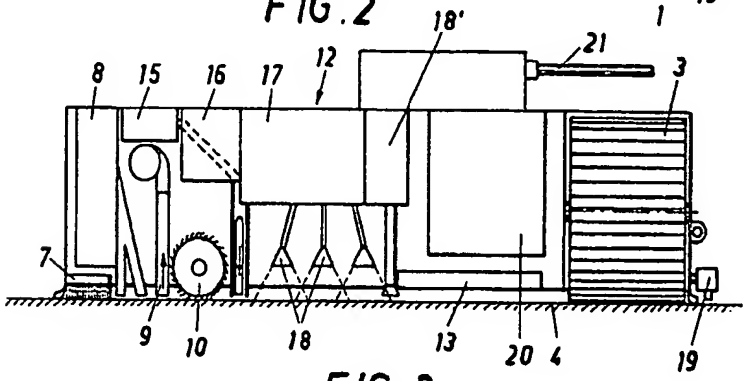

FIG. 3

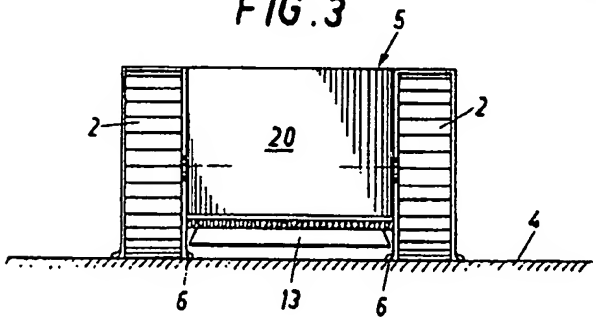

FIG. 4

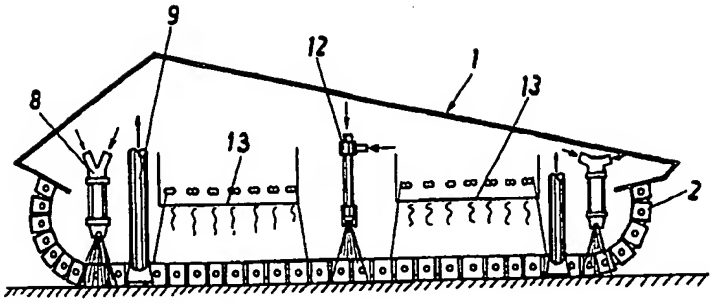

FIG. 5

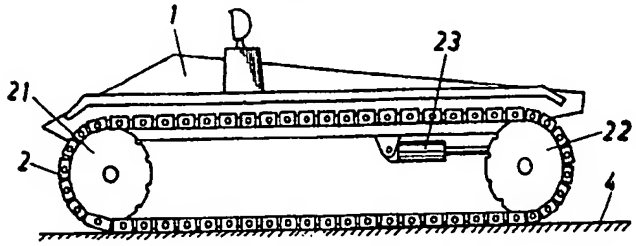

FIG. 6

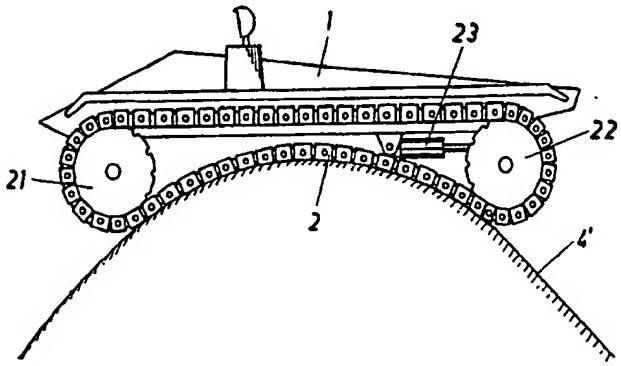

FIG. 7

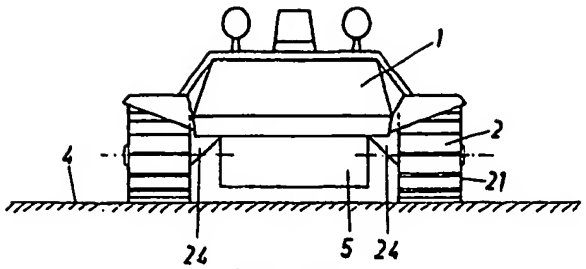

FIG. 8

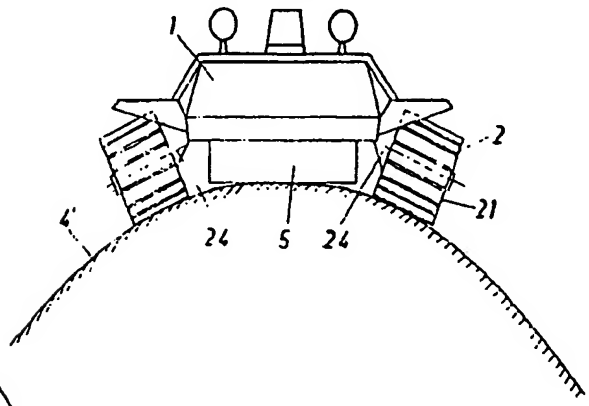

FIG. 9